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A SHOVEL-TUSKED GOMPHOTHERE FROM THE MIOCENE OF KENYA

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ABSTRACT. A tusk fragment of the first recorded occurrence in Africa of *Platybelodon*, a shovel-tusked gomphothere, is described, and its relationships to the Asiatic and North American representatives of the Amebelodontinae are discussed. It is suggested that the African form represents a very early member of the group, and that Africa may have been the place of origin of the subfamily.

INTRODUCTION

In 1927, E. H. Barbour described as *Amebelodon fricki* the first specimen of a rather bizarrely specialized group of proboscideans, the shovel-tusked gomphotheres — Amebelodontinae. The geological and geographical range of this subfamily has hitherto been believed to extend from the late middle Miocene (Tortonian)¹ of Asia to the late Pliocene of North America. Osborn (1936) proposed a subfamilial separation of the North American *Amebelodon* from *Platybelodon*, which occurs in both North America and Asia, suggesting an independent origin of the two genera — *Amebelodon* in North America from a stock of the “Bunomastodontidae” and *Platybelodon* from the “Serridentidae” in Asia. Gregory (1945) considered the two genera to represent a more closely related group than did Osborn and placed them both in a single subfamily, the Amebelodontinae. This is the view subscribed to here. Until now, it has seemed likely that the shovel-tusked gomphotheres originated in Asia from a stock of the Gomphotheriidae sometime during the early to middle Miocene,

¹ *Platybelodon danovi* Borissiak, the earliest known species, occurs in the Chokrak beds of the Kuban region in the North Caucasus, considered to be of late middle Miocene age (Tortonian of western Europe) by Nalivkin (1960).

migrating to North America during the early Pliocene. The specimen described in the present note, however, demonstrates the presence in east Africa during middle Miocene time of shovel-tusked gomphotheres very similar to the Asiatic amebelodontines.

The fragment (MCZ field number 38-64K) was collected by Mr. James G. Mead during the 1964 field season of the Museum of Comparative Zoology expeditions to east Africa² directed by Professor Bryan Patterson. The locality is 35° 50' E, 02° 20' N, approximately 4 mi. NNE of the site of the abandoned town of Loperot and 50 mi. SSE of Lodwar, in the Loperot area of southern Turkana District, northwestern Kenya (map in Joubert, 1966). Although none of the associated fauna has yet been studied in detail, the following elements have been identified: *Deinotherium hobleyi*, *Dorcatherium* sp. cf. *D. pigotti*, *Chilotherium* sp., ?*Brachyodus* sp., and hyracoid aff. *Prohyrax*.

The specimen, weathered from the Turkana Grit, was found on the surface near the top of the formation, about 20 feet below a fine-grained olivine basalt sequence. Joubert recognized three successive basaltic flows overlying the Turkana Grit in this region and on geological evidence placed the onset of the basal flow in the Lower Miocene (1966: 35). The associated fauna collected from the Turkana Grit is not wholly incompatible with this view, in that it appears to be close to those in the Rusinga series and, although less so, to that of Lothidok,³ both usually considered to be of early Miocene age.

Although detailed faunal comparison is not possible at present, the Loperot fauna probably correlates with part of the Rusinga complex⁴; it does not appear to be equivalent to that of Lothidok. *Dorcatherium pigotti* and *Chilotherium* sp. occur on Rusinga Island.

² The field work was supported by National Science Foundation Grant GP-1188.

³ The name Losodok as used by Arambourg (1933), Whitworth (1954), and Hooijer (1966), is replaced by the name Lothidok on most current geologic maps of the area, as, for example, SK. 57 Kenya, 1:1M (Special), Survey of Kenya, 1965.

⁴ As Simpson has recently emphasized (1967: 43), the stratigraphic and faunal successions at Rusinga are at present inadequately known, as are the facies and age relationships of the several other earlier Miocene faunas known from the Kavirondo Gulf region. Evidence in support of the often quoted "early Miocene" age, or indeed of any other age, for these deposits is inconclusive, although they are almost certainly older than those at Fort Ternan, for which an acceptable age (12-14 million years) is available. The

The hyracoid is close to, but lower crowned than, *Prohyrax* from Langental, South Africa (Stromer, 1926), and may be the same as *Meroëhyrax* from Rusinga (Whitworth, 1954). The Lothidok fauna includes *Dorcatherium chappuisi*, *Megalohyrax championi* (see Whitworth, 1954), and *Aceratherium acutirostratum*.

The lowest basalt in the Loperot sequence has been dated at 17.5 ± 0.9 million years by Geochron Laboratories, Inc., using the Potassium/Argon method (Patterson, personal communication). This date indicates a Vindobonian age for the basalt immediately overlying the fossil-bearing sediments. There does not appear to be any significant time interval between deposition of the upper part of the Turkana Grit and the basalt flow, and this age is here considered approximately correct.

The specimen under discussion is too fragmentary for positive identification, but, as far as can be determined from what remains, the form it represents was closely related to *Platybelodon*. It is therefore tentatively placed in that genus, pending further knowledge.

PLATYBELODON SP.

The specimen (Fig. 1) is a fragment from the middle of a left lower incisor, and measures 56.8 mm in maximum length. The upper surface is broadly concave and the lower convex. The two surfaces are not parallel but diverge somewhat towards the sides, so that the tooth is thicker along the medial and lateral edges than at the center. The medial edge is flattened, with a broad, shallow, concave groove along the entire length of the fragment; the two lower incisors may have been closely appressed during life, at least in this region of the tusk. The specimen tapers in all dimensions toward one end, which is probably anterior. A similar tapering toward the tip of the tusk is seen in more complete specimens of other amebelodontines, e.g., the specimen of *Anebelodon fricki*

age of 15.3 million years suggested by Evernden *et al.* (1964) as the maximum for the Rusinga series seems unlikely. The sample used for this determination was taken from a locality at the base of Kiahera Hill and, as suggested by Savage (1965) and Leakey (1967), these deposits may not be part of the Kiahera Series, supposedly the oldest formation on Rusinga Island. Until the deposits of Rusinga are better understood, correlation within the east African Miocene will remain uncertain.

The relative position of the various deposits within the Miocene depends in part on the inclusion in or exclusion from this epoch of the Aquitanian and Pontian stages.

described by Gregory (1945). The medial thickness tapers from 14.6 mm to 11.6 mm anteriorly. The lateral edge is thinner than the medial and measures 8.5 mm to 7.0 mm. In overall width, the fragment decreases from 78.5 mm to 74.5 mm.

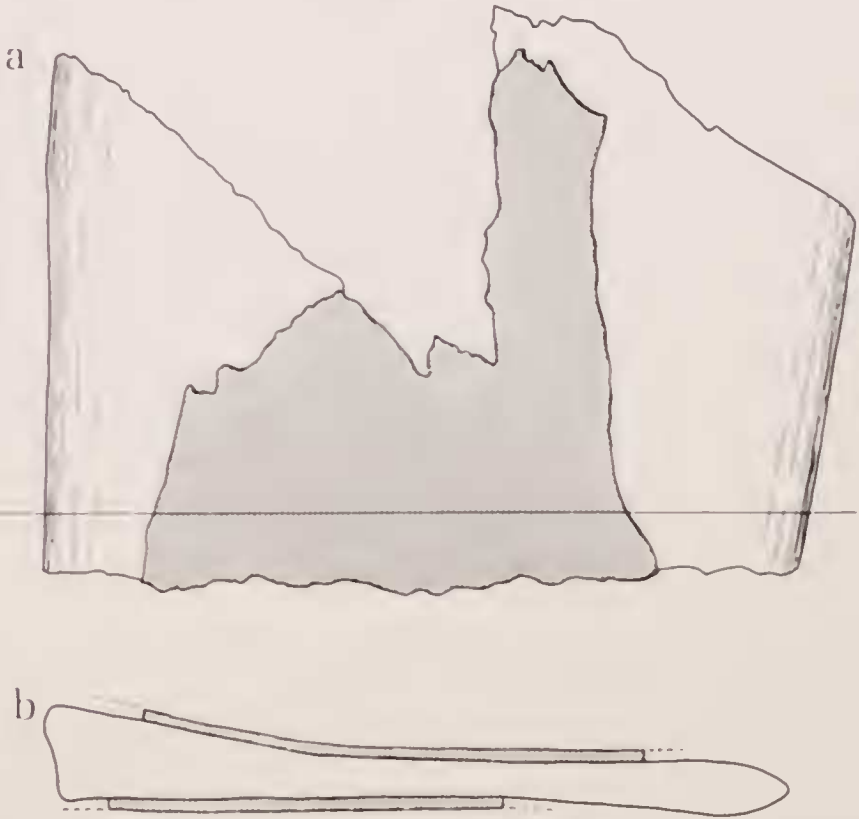


Figure 1. *Platybelodon* sp. Tusk fragment, MCZ field number 38-64K, from the Loperot area, Kenya. *a*, Dorsal view; horizontal line indicates plane of section. *b*, Anterior view of cut surface. Shaded area, investment of laminated dentine. $\times 1$.

The broken ends reveal a complex internal structure of dentine organized into *dentinal systems*⁵ or rodlike masses as in most other amebelodonts, although they have not weathered out as discrete and isolated rods, such as those described in *Platybelodon grangeri* (Osborn and Granger, 1931) and *Amebelodon fricki* (Barbour, 1941). In thin section (Fig. 2), the dentine has a fibrous texture, consisting of numerous microscopic dentinal tubules. These tubules

⁵ The term *dentinal system* was restricted by Tomes (1850) to that portion of a tooth consisting of a canal from which dentinal tubules radiate and around which there is no investment of enamel.

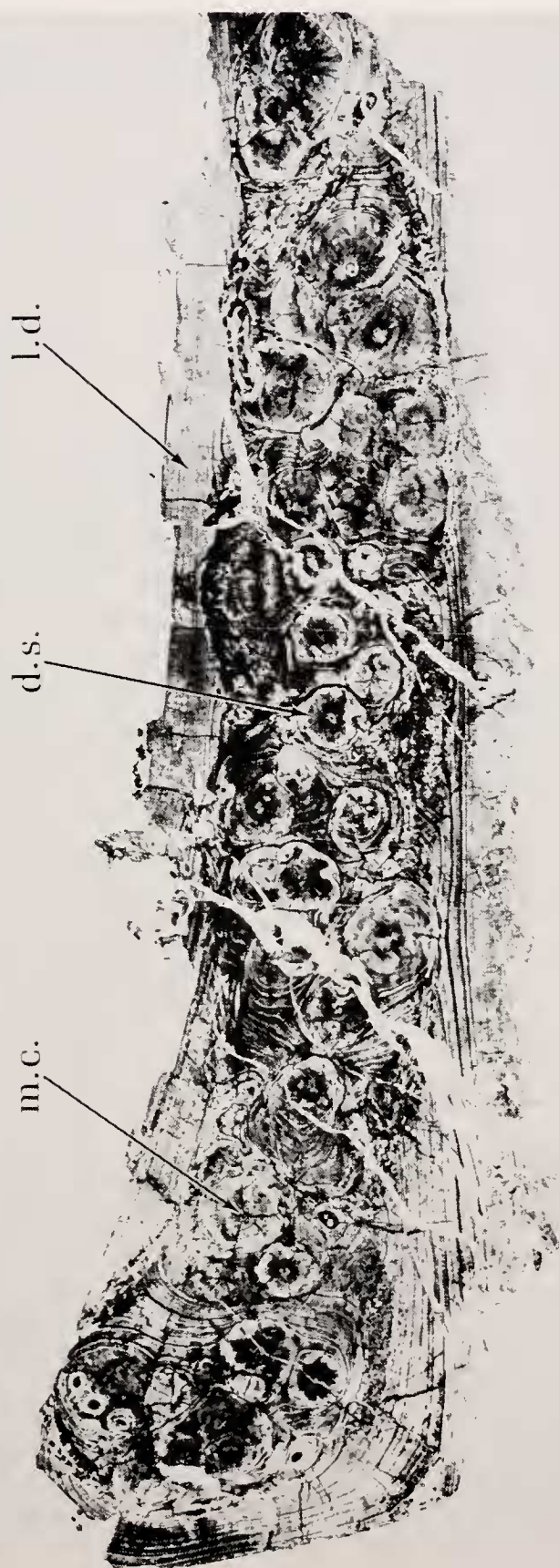


Figure 2. *Platybelodon* sp. Thin section of tusk fragment showing medial half of cross-section; composite photograph using transmitted light. *d.s.*, Dentinal systems. *l.d.*, Laminated dentine. *m.c.*, Medullary canal. $\times 4$.

appear to radiate from the center of each dentinal system and may curve partially around its outer edge. Near the center of each dentinal system is a round to irregularly shaped canal, secondarily filled with calcite, as are the numerous small cracks which cut across the tubule boundaries. The canals probably correspond to the "small lumen" noted in the dentinal systems ("rod-cones") of *Platybelodon* by Osborn (1936: 465). The tooth is thus composed of a series of dentinal systems, each with a medullary canal as in *Orycteropus* (Tomes, 1850).

Some of the dentinal systems are closely aggregated into bundles of two or three. A laminar substance is seen to swirl around and between the systems and bundles, completely filling the spaces between them. Optically, this material resembles dentine; its structure is that of dentine and in no way resembles that of cement. Such a condition has been described by Tomes (1850) as *confluent dentinal systems*, in which "parallel dentinal systems are united to each other, throughout their length, by a thin longitudinal lamina of dentine."

The individual dentinal systems are large, about one and one-half mm in diameter, and loosely packed; there are approximately 70 visible on the complete cross-section of the tusk in the region represented by the fragment. This is in strong contrast to the very small, discrete dentinal systems found in *Platybelodon grangeri*, in which there are about 250 in the cross-section (Osborn and Granger, 1931). In a tusk referred to *Amebelodon fricki* (Colorado Museum no. 1319), Osborn and Granger noted the presence of dentinal systems ("rod-cones") "larger and much less numerous" than in *P. grangeri*, the total number being estimated at 100 to 150. Dentinal systems have not been definitely recognized in *Platybelodon danovi*, although Osborn (1936: 462) interpreted the "irregular longitudinal grooves," described by Borissiak (1928) on the upper surface of the tusk, as indicating their presence. If, however, *P. danovi* was ancestral to *P. grangeri*, or at least represented a more primitive type, we might expect the internal structure of the tusk to be less advanced and closer to that of the African form.

The outer surface of the tooth was sheathed in life by a thick (1.5 mm) layer of what appears to be strongly laminated dentine with dentinal tubules oriented perpendicular to the surface. This superficially resembles enamel, but its internal edge is seen to merge into the underlying dentine, with which the tubules are continuous, without the sharp contact and contrasting structure characteristic of dentine-enamel junctions. Its microscopic structure is also not

at all like that of cement. This sheath has been broken away from much of the tooth surface, but enough remains to indicate its former presence over the entire fragment; there is no indication of enamel or cement.

In the degree of flattening, the present specimen exceeds *Platybelodon danovi* and approaches *P. grangeri*, which shows the most extreme flattening of any species of the subfamily yet described. In size, the African form, as determined from available measurements, is the smallest amebelodont, with a tusk width about 28 per cent smaller than in *P. danovi*.

DISCUSSION

The present specimen demonstrates that by Vindobonian times a shovel-tusked gomphothere was present in east Africa. The internal modifications of the dentine into discrete dentinal systems, presumably for strengthening the tusk, were in a relatively rudimentary stage as compared with those of *P. grangeri*, being large, loosely compacted, and generally poorly defined. Yet if the degree of flattening can be used to infer the degree of adaptation to a relatively specialized ecological role, we must conclude that the present form had already reached a degree of specialization with respect to tusk shape equal to that of *P. grangeri*, despite the relatively primitive organization of the dentinal systems.

It appears reasonable to suggest that the present form represents (with *P. danovi*) an early specialization toward the adaptations that were to characterize the later amebelodonts. Its exact relationship to the Asiatic representatives of this genus is uncertain, but in view of its similarity to those species, as far as can be determined from this specimen, a close relationship to *P. danovi* may be suggested, both forms being among the earliest members of the subfamily.

The question arises as to the place of origin of the Amebelodontinae. The mere presence of this group in east Africa during the Miocene does not, of course, positively answer this question. However, unless the African form proves, on further evidence, to be an independent adaptation to this particular ecological situation, the existence of this group in Africa and Asia at roughly the same time suggests a possible African origin for the subfamily. This view becomes more probable when one considers the long prior evolutionary history of the Gomphotheriidae in Africa and their relatively late appearance in Eurasia during the early Miocene. It is to be hoped that further specimens will be unearthed and also that among

the isolated gomphothere teeth and bones from the African Miocene in museum collections additional remains of this group will be recognized.

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TABLE 1

Comparative measurements of *Platybelodon* species from Asia with *Platybelodon* from Africa, in mm

	AMNH 26200			
	<i>P. danovi</i> ¹ Type	<i>P. grangeri</i> ¹ Type	MCZ 38-64K ²	MCZ 38-64K ³
width	110	166	79.5	74.5-78.5
medial thickness	30	33	16.1	11.6-14.6
lateral thickness	15	25	10.8	07.0-08.5
medial thickness width	0.272	0.199	0.224	—
average thickness width	0.201	0.175	0.169	—

¹ Measurements for *P. danovi* and *P. grangeri* taken from Osborn and Granger (1931, p. 2).

² Estimated mean measurements corrected for missing outer layer of laminated dentine.

³ Actual measurements of specimen.

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